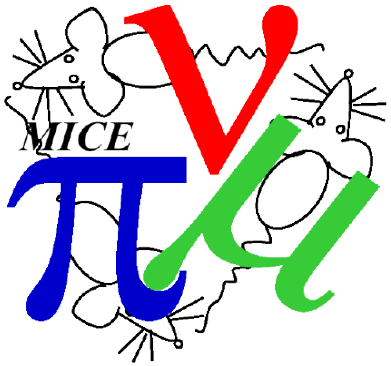
MICE Step Pi – Symmetric Lattice



Chris Rogers,
ASTeC,
Rutherford Appleton Laboratory

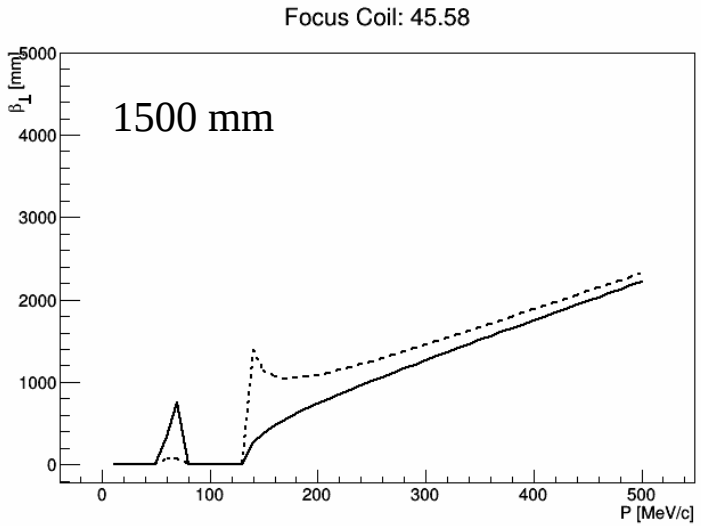
Geometries

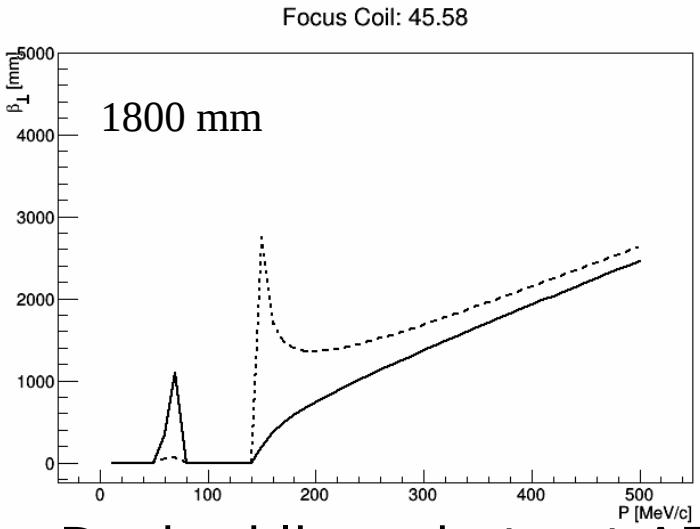
- Symmetric Lattice
- Lengths
  - AFC = 422 mm
  - Bellows = 56 mm
  - Single cavity module (1xRF) = 600 mm
  - Double cavity module (2xRF) = 900 mm
  - Absorber = 200 mm (complete guess)
- Three lattices to be considered
  - Single cavity: AFC+bellows+1xRF+bellows+AFC ~ 1500 mm
  - Double cavity: AFC+bellows+2xRF+bellows+AFC ~ 1800 mm
  - Double cavity and absorbers: AFC+bellows+RF+absorber+RF+bellows+AFC ~ 2000 mm
- Treat cooling cell and matching from spectrometers as separate problems to first approx

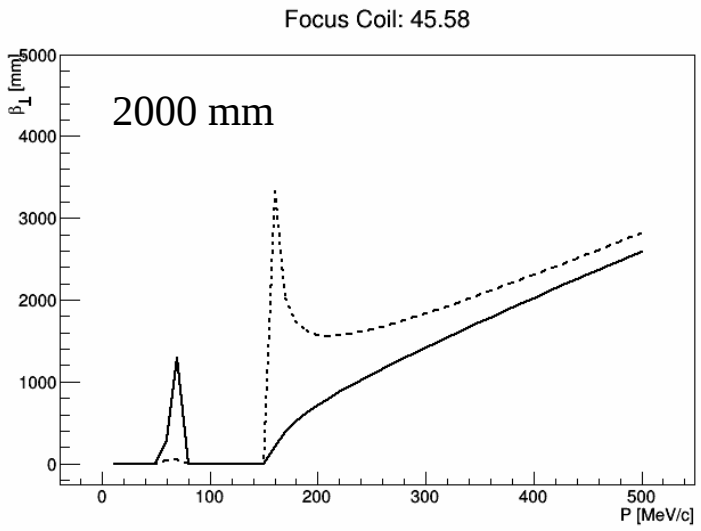
Optics

- 2 Focus coil pairs → four possible arrangements
  - ++++
  - ++-- (not studied yet)
  - +--+
  - +-+-
- Seek a solution for p = 200 MeV/c initially
  - Want beta at absorber < 1 m for reasonable cooling
  - Note that AFC is at the antifocus for this sort of lattice

++++ (solenoid mode)







- Dashed line – beta at AFC
- Full line – beta at centre
- 1500 mm is marginal for beta at AFC
- 1800 mm – probably no cooling
- 2000 mm – okay for beta at centre
- Some fine tuning of FC current possible

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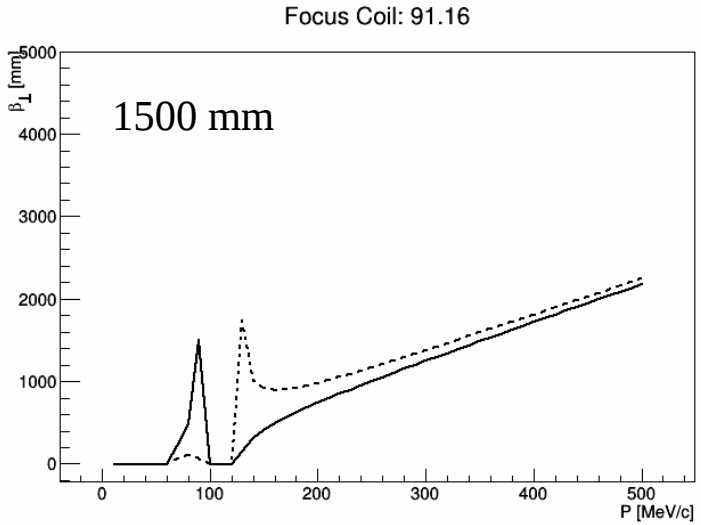
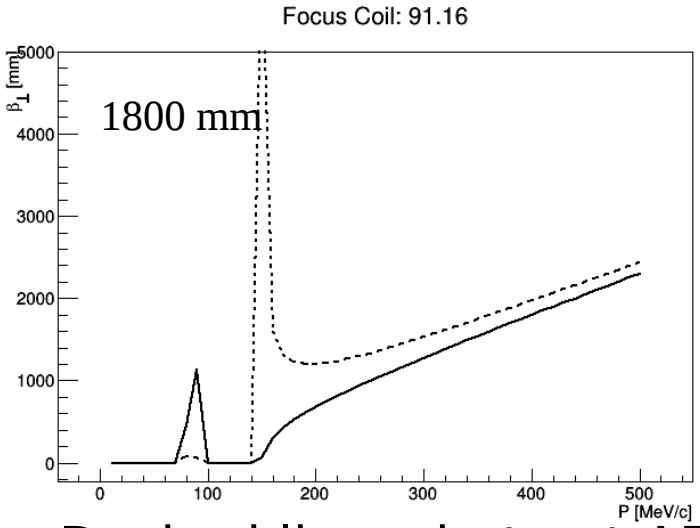
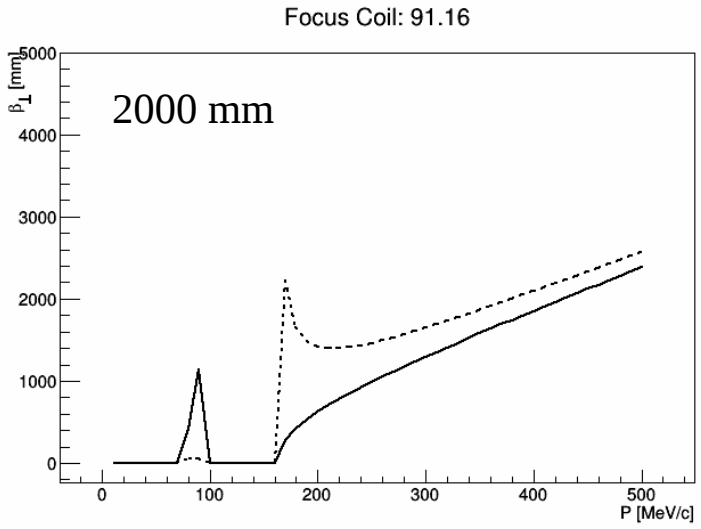
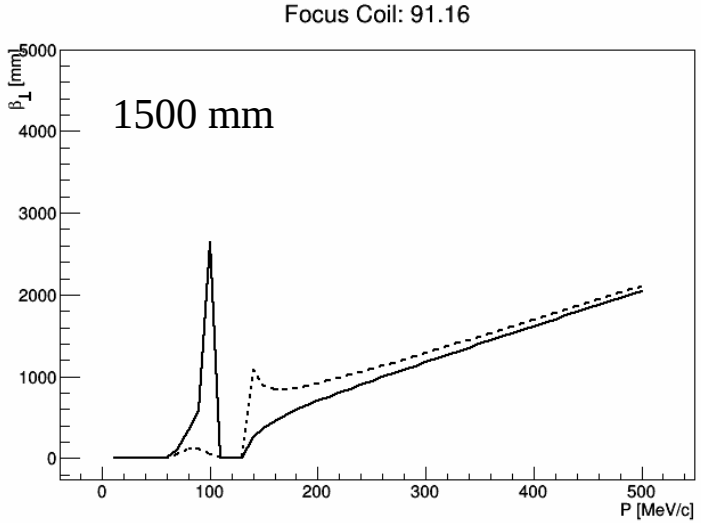


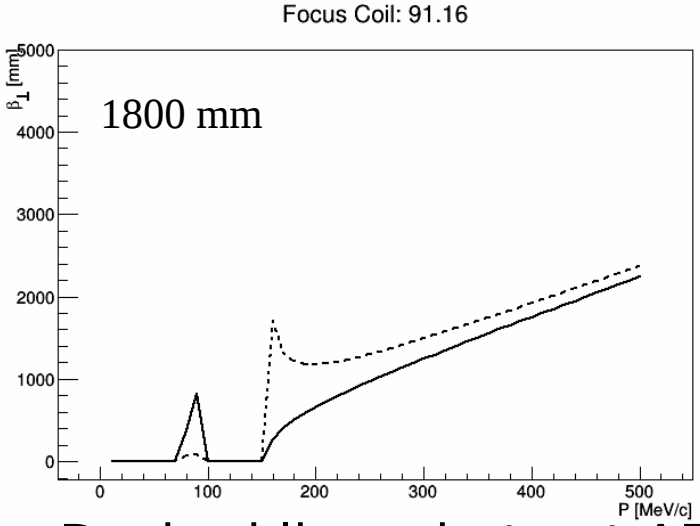


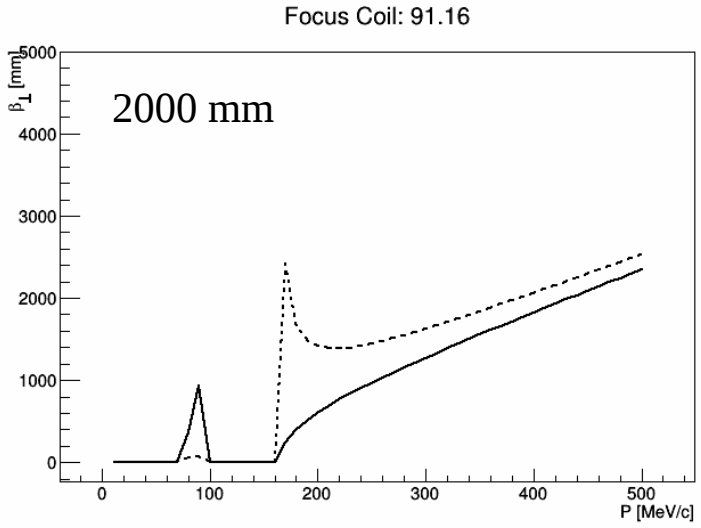


- Dashed line – beta at AFC
- Full line – beta at centre
- 1500 mm is marginal for beta at AFC
- 1800 mm – probably no cooling
- 2000 mm – okay for beta at centre
- Sounds familiar?

+--+







- Dashed line – beta at AFC
- Full line – beta at centre
- 1500 mm is marginal for beta at AFC
- 1800 mm – probably no cooling
- 2000 mm – okay for beta at centre
- Landscape is similar to +-+-

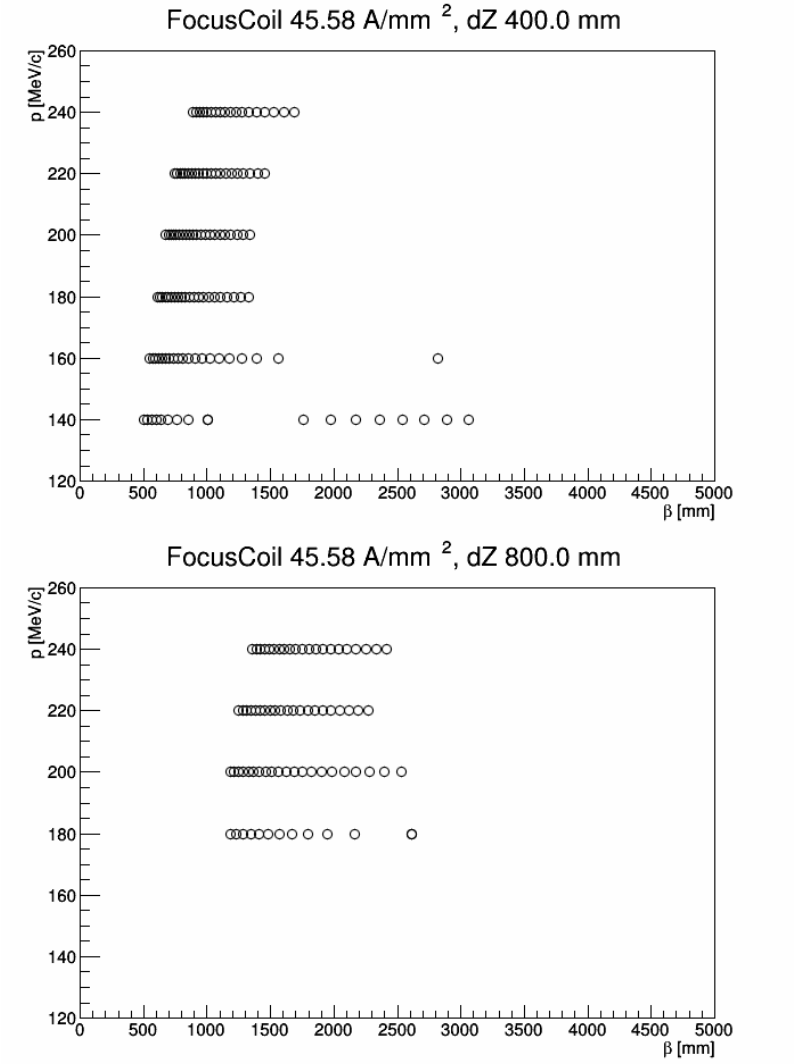
Symmetric Lattice - conclusions

- 1800 mm (double RF lattice)
  - Beta at AFC is too large
  - Probably won't cool very well
- 1500 mm (single RF lattice)
  - Beta at AFC can be reasonably small
  - Probably will cool okay
  - Only one RF cavity → not much reacceleration
  - 7 MeV with step V RF power (4 MW)?
  - 10 MeV with step VI RF power (8 MW)?
- 2000 mm (double RF + absorber)
  - Absorber is now moved to focus
  - Beta at absorber can be reasonable
  - Two RF cavities → better reacceleration
  - Need to consider tracker shielding
  - Need to consider engineering – can absorber really be in centre
  - Need to check apertures

Matching

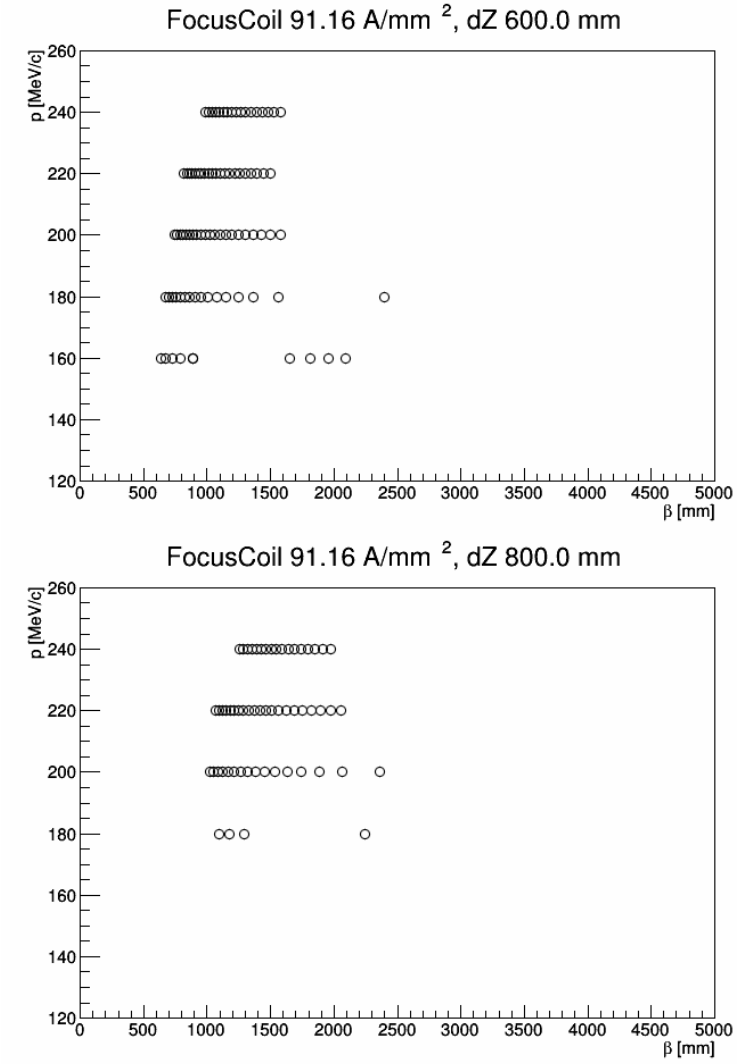
- Can we match into these lattices?
  - For Step V, beta at absorber ~ 400 mm
  - Now beta at absorber ~ 1000 – 2000 mm
  - Previous studies have shown this is out of range for as-designed SS
- Consider inserting gap between SS and AFC
  - Give the beam a chance to grow to get into AFC
- Use Step IV lattice as a matching test-bed
  - Close enough to step pi
  - Follow-up job to match into the step pi lattices properly
- Two cases to match into
  - Flipping mode +-
  - Solenoid mode ++

Solenoid mode



- Seek a match at beta = 1000 mm for cell length 1500 mm
  - Additional 400 mm gap seems about right
- Seek a match at beta = 1500 mm for cell length 2000 mm
  - Additional 800 mm gap seems about right
  - Note that no match was found for p <= 160 MeV/c

Flip mode



- Seek a match at beta = 1000 mm for cell length 1500 mm
  - Additional 600 mm gap seems about right
- Seek a match at beta = 1500 mm for cell length 2000 mm
  - Additional 800 mm gap seems about right
  - Note that no match was found for p <= 180 MeV/c
    - May be a little unstable
    - Some further iteration required

Matching - conclusions

- Can we match into these lattices?
  - Yes, but would require additional spacing between spectrometer solenoid and AFC
  - 400-500 mm seems about right for single RF option
  - 600-800 mm seems about right for double RF + absorber option